

The Designing and Weighting of Key Performance Indicators using the SCOR Approach and AHP in XYZ Weaving Company

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ABSTRACT

Competition between companies is becoming more intense, which is why each company must improve their performance. Supply Chain Management becomes an important part of a company in order to determine an efficient business strategy. One way is to measure supply chain performance. The first step that must be taken is to determine and weigh the Key Performance Indicator as a measurement of supply chain performance measurement in XYZ Weaving Company with the Supply Chain Operations Reference (SCOR) approach. The result of the study is that there are 23 KPIs with their respective weights on each level. The highest weight on Level 1 is on the Make process; with a weight value of 0.357. The highest weight on level 2 is on the Reliability variable; with a total weight of 0.424, while the highest weight on level 3 is on the Time needed to manufacture products; with a total weight of 0.067.

KEYWORDS: SCM, SCOR, KPI, AHP

How to cite this paper: Ni Kadek Jayanthi Nilasari "The Designing and Weighting of Key Performance Indicators using the SCOR Approach and AHP in XYZ Weaving Company" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-3, April 2020, pp.251-256, URL: www.ijtsrd.com/papers/ijtsrd30348.pdf



IJTSRD30348

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INTRODUCTION

Today's business competition has developed into a global competition. Every company is competing to improve its operational performance so that the continuity of the entire supply chain from suppliers to consumers can run smoothly. Supply Chain Management (SCM) is a major part of a company in improving its performance. It can answer a company's problems in order to determine strategies in building excellence in competitive competition [1]. It is able to collaborate with several other companies; such as suppliers, distributors and retailers - to merge the flow of inventory activities, starting from purchasing raw materials to turning them into finished products and deliver them to consumers. The intended movement flow includes the flow of information, product and financial movements [2].

The performance measurement system has several benefits; including monitoring and controlling, communicating organizational goals to functions in the supply chain, find out where the position of an organization is relative to competitors and the objectives to be achieved, as well as determining the direction of improvement to create competitive advantage. Measuring the performance of a company's supply chain can be done with the Supply Chain Operations Reference (SCOR)

approach [3]. XYZ Weaving Company is one of the industries producing traditional woven fabrics from Bali, Indonesia. All companies continue to strive to fulfill customer orders and provide satisfaction to them.

One effort which can be done is by measuring supply chain performance in companies; that function to achieve company goals. However, prior to that, XYZ Weaving Company must determine their Key Performance Indicator as a benchmark in measuring the supply chain performance. The KPI is expected to be an early stage in measuring supply chain performance using the Supply Chain Operations Reference method.

RELATED WORKS

There is a previous research which was carried out by S. Haldar, C. L. Karmaker and SR. K. Hossain in 2018 - entitled, "A Framework to Evaluate and Improve Supply Chain: FAHP Based Case Study on a Supermarket". This research obtained some of the most effective factors to evaluate performance based on the decision-making method with FAHP, which is inventory management. This result revealed that managing inventory, sharing internal information and accurate demand forecasts are very important factors [4].

There is also a previous research which was conducted by Evan Rosiska in 2018 - entitled, "Penerapan Metode

Analytical Hierarchy Process (AHP) dalam Menentukan Mitra Usaha Berprestasi". This research contained ways to determine business partners who excel with the AHP method. The result showed that TT travel is on the first rank (32%), Celebes is on the second rank (22%), Putri Persada is on the third rank (17%), Lucia is on the fourth rank (15%), and Filkana is on the fifth rank (11%) [5].

Furthermore, there is a previous research which was conducted by Adnan Aktepe and Suleyman ERSOZ in 2011 – entitled, "A Fuzzy Analytic Hierarchy Process Model for Supplier Selection and A Case Study". This research discussed multi-criteria decision making with the Fuzzy Analytic Hierarchy Process method in the field of Supply Chain Management [6].

RESEARCH METHOD

The flow of research that includes the steps undertaken in this study can be seen in Figure 1.

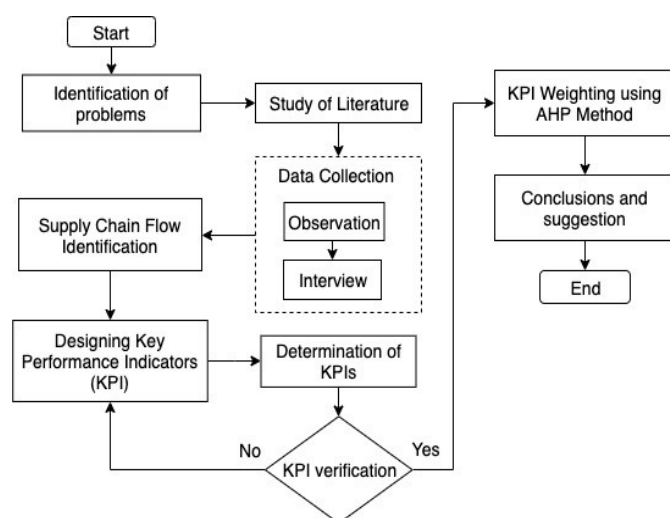


Fig.1. Research Methodology

Figure 1 represents the stages of the research process from the analysis of the SCOR method approach to measure the performance of a company's supply chain.

THEORETICAL FRAMEWORK

Literature review contains supporting theories in the research to be conducted. These theories include SCM, SCOR, Measurement of Supply Chain Performance, and AHP.

1. Supply Chain Management

Supply Chain Management (SCM) is a major part of a company in improving its performance. It includes several parties working together to collaborate on creating strategies and increasing the efficiency of the company's operational performance. It can answer a company's problems in order to determine strategies in building excellence in competitive competition [1]. It is able to collaborate with several other companies; such as suppliers, distributors and retailers - to merge the flow of inventory activities, starting from purchasing raw materials to turning them into finished products and deliver them to consumers. The intended flow of movement includes the flow of information, product and financial movements [2].

2. Measurement of Supply Chain Performance

Supply chain performance is defined as the ability of the supply chain to deliver the right product to the right location at the right time; with the lowest logistics costs. This definition takes into account the delivery time, cost, as well as the value for the final consumer. The measurement of supply chain performance covers the most important aspects of supply chain [7]. There are three basic criteria for performance evaluation [8], which are:

- 2.1. Success, which is the relationship between the results and goals achieved. This is related to the level of customer satisfaction in relation to the resources made to achieve the goals.
- 2.2. Efficiency, which is the relationship between the effort and resources involved in operations and the actual utility value as a result of actions. This is related to achieving goals at lower costs.
- 2.3. Effectiveness, which is related to satisfaction with the result that have been achieved.

3. Supply Chain Operations Reference

The Supply Chain Operation Reference (SCOR) model was created in 1997 by a coalition of a large number of logistics organizations and practitioners. They established a supply chain board to analyze the phenomenon in terms of its management from a global and inter-organizational perspective. Their purpose is to provide a conceptual tool to increase the effectiveness of supply chain operations that can be used by business partners in their trade.

The SCOR model applies traditional business processes in an inter-organizational environment to describe all interactions which occur in logistic or production value chains that result from the return of goods or defective goods [9]. The SCOR model helps to create a shared vision in management and manage five main supply chain processes; which consist of plan, source, make, deliver and return [10].

4. Five Core Processes in the SCOR Model

The SCOR model divides supply chain processes into five core processes; which are plan, source, make, deliver and return. An overview of core processes in the SCOR Model can be seen in Figure 2.

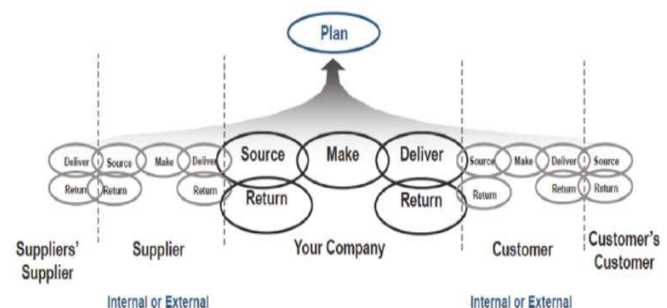


Fig.2. Five Core Processes in the SCOR Model

The SCOR model has been developed to describe business activities related to all phases in its purpose to fulfill customers' demand. The model itself contains several parts and is composed of five main management processes; which are Plan, Source, Make, Deliver and Return. SCOR also has 5 performance attributes, which are Reliability, Responsiveness, Agility, Cost, and Assets.

5. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a process which helps decision-makers to obtain the best solution by decomposing complex problems into simpler forms and synthesizing the various factors involved in the issue of decision making. It considers the qualitative and quantitative aspects of a decision and reduces the

complexity of a decision by making one-on-one comparisons of the various criteria chosen, to process and obtain the results later. This technique not only helps decision-makers to obtain the best alternative solutions, but it also provides a clear rational understanding of the choices made [11].

RESULT AND DISCUSSION

1. SCM Business Process

The first stage is to identify the supply chain flow in the XYZ Weaving Company, which is useful to find the Key Performance Indicator to be analyzed.

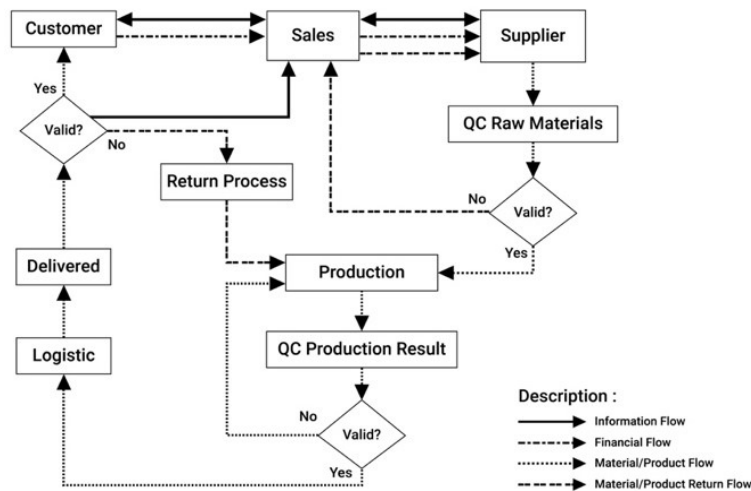


Fig.3.SCM Business Process in the XYZ Weaving Company

The business processes of X Weaving Company are described by an analysis of four types of supply chain management flow; which are the flow of information, finance, material and return material - to determine the Key Performance Indicator

2. Key Performance Indicator Identification

Key Performance Indicators to be measured can be seen in Table 1. The following Key Performance Indicators are obtained from an analysis of business processes in the XYZ Weaving Company.

Table1. KPI Determination Result

Core Processes (Level 1)	Performance Attributes (Level 2)	Number of KPI	Key Performance Indicator (Level 3)
Plan	Reliability	1	Estimated accuracy of raw materials
		2	The amount of meetings with suppliers
	Responsiveness	3	The time needed to identify new products
		4	The time needed to draw up a production schedule
Source	Assets	5	Cash to cash cycle time
	Reliability	6	Percentage of accuracy of the amount of raw materials sent by suppliers
		7	The amount of raw materials that are free from defects
		8	The amount of raw materials that are undamaged during the shipping process
	Responsiveness	9	The time needed to publish the purchase order
		10	The time needed to receive raw materials from suppliers
Make	Flexibility	11	Suppliers availability
	Assets	12	Daily supplies
	Reliability	13	Suitability in fulfilling production targets
		14	The number of defective products during the production process
		15	The time needed to manufacture products
	Responsiveness	16	The speed in responding to a variety of customer orders
Deliver	Reliability	17	Percentage of accuracy of delivery goods to consumers seen from the item
		18	Percentage of the accuracy of shipping goods to consumers seen from the quantity
	Responsiveness	19	Delivery performance in accordance with the predetermined time
		20	The time needed since the demand until the goods are received by consumers.
Return	Reliability	21	The speed in responding to sudden delivery requests
		22	The number of complaints from consumers
		23	The time needed to resolve complaints from consumers

3. Weighting with the AHP method

Weighting is done to determine the weight of each matrix. The result from weighting is obtained from the questionnaire assessment of respondents who know the condition of the company best.

Table2. Pairwise Comparison Matrix

Proses	Plan	Source	Make	Deliver	Return
Plan	1	2	1/2	1	1
Source	1/2	1	1/2	2	3
Make	2	2	1	3	3
Deliver	1	1/2	1/3	1	1
Return	1	1/3	1/3	1	1

Table 2 outlines the result of the pair wise comparison matrix on SCOR Level 1. On this stage, a comparison assessment is performed between one criterion with the other criteria.

Table3. Normalization To Find Out The Priority Weight

Proses	Plan	Source	Make	Deliver	Return	Total	Priority Weight
Plan	0,182	0,34	0,19	0,13	0,11	0,95	0,194
Source	0,091	0,17	0,19	0,25	0,33	1,03	0,206
Make	0,364	0,34	0,38	0,38	0,33	1,79	0,357
Deliver	0,182	0,09	0,12	0,13	0,11	0,63	0,125
Return	0,182	0,06	0,12	0,13	0,11	0,60	0,118
Total	1	1	1	1	1	5,00	

Table 3 is the normalization result of pair wise comparison matrix. After finding out the normalization of each cell, each column is then added up to determine the weight of each criterion by means of the sum of each column divided by the total rows. To find out whether the matrix is consistent, the matrix consistency test is calculated afterwards. The next step is to test the consistency of the weight that has been obtained

3.1. Finding the value of [A] = matrix x priority weight

$$\begin{array}{ccccc|ccccc}
 & \text{Matrix} & & & & \text{Priority Weight} & & & \text{Vector [A]} \\
 1 & 2 & 0,5 & 1 & 1 & 0,190 & & & 1,03 \\
 0,5 & 1 & 0,5 & 2 & 3 & 0,207 & & & 1,09 \\
 2 & 2 & 1 & 3 & 3 & 0,358 & = & & 1,89 \\
 1 & 0,5 & 0,333 & 1 & 1 & 0,126 & & & 0,66 \\
 1 & 0,333 & 0,333 & 1 & 1 & 0,120 & & & 0,62
 \end{array}$$

3.2. Finding the Vector B = $\frac{\text{Vector [A]}}{\text{Priority Weight}}$

$$\begin{array}{lcl}
 \text{Vector B} & = & \begin{array}{ccccc} 1,03 & 1,09 & 1,89 & 0,66 & 0,62 \\ 0,190 & 0,207 & 0,358 & 0,126 & 0,120 \\ 5,42 & 5,28 & 5,27 & 5,23 & 5 \end{array} \\
 & = &
 \end{array}$$

3.3. Finding the Maximum Eigenvalue

$$MEV = \frac{\text{Number of Elements in Matrix B}}{N}$$

$$\begin{aligned}
 &= \frac{5,42 + 5,28 + 5,27 + 5,23 + 5}{5} \\
 &= 5,28
 \end{aligned}$$

3.4. Finding the Consistency Index

$$\begin{aligned}
 CI &= \frac{MEV - N}{N - 1} \\
 &= \frac{5,28 - 5}{5 - 1} \\
 &= 0,07
 \end{aligned}$$

3.5. Finding the Value of Random Consistency Index (RI)

For N = 5, then the value of Random Consistency Index = 1,12

3.6. Finding the Consistency Ratio

$$\begin{aligned} CR &= \frac{CI}{RI} \\ &= \frac{0,07}{1,12} \\ &= 0,006 \end{aligned}$$

Based on the calculations made throughout the entire Plan, Source, Make, Deliver and Return process; it is found that the Maximum Eigen Value is 5.03 - with a Random Consistency Index (RI) of 1.12 and a Consistency Index (CI) of 0.01. By using the CI / IR formula, a Consistency Ratio (CR) of 0.006 is obtained, where the value ≤ 0.1 indicates that the data used are consistent and can be justified to do the calculations. KPI weighting can also be done using Expert Choice software. The result of data processing in the Expert Choice software can be seen in Figure 4.

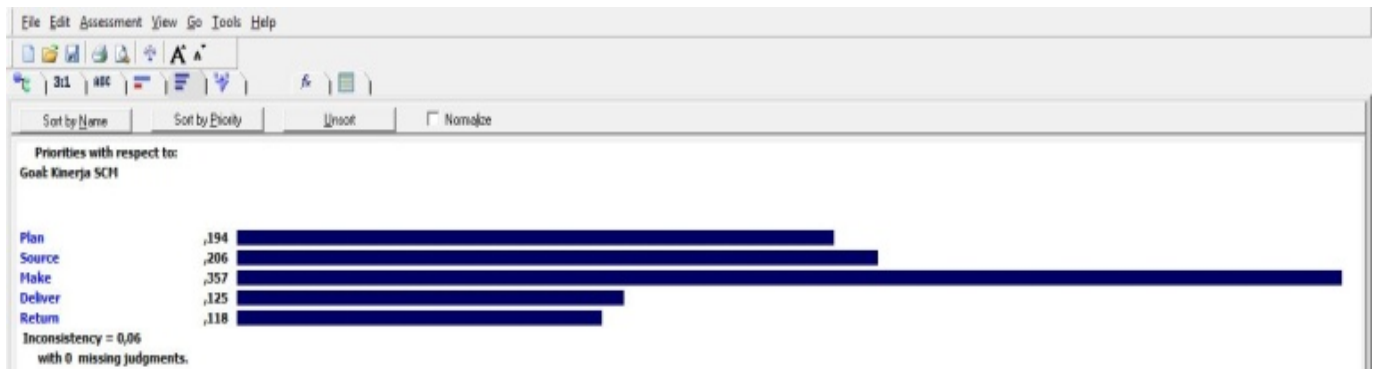


Fig.4. Weighting through Expert Choice Software

Figure 4 shows the weighting result from the SCOR core processes with consistent result. KPI weighting on level 2 and 3 are also carried out using Expert Choice software. The result of all the weights can be seen in Table 4.

Table4. Kpi Weight Value on Level 1, 2 And 3

Core Processes (Level 1)	Weight	Performance Attributes (Level 2)	Weight	KPI (Level 3)	Weight
Plan	0,194	Reliability	0,062	1	0,023
		Responsiveness	0,054	2	0,020
				3	0,024
Source	0,206	Assets	0,046	4	0,031
		Reliability	0,082	5	0,033
				6	0,038
				7	0,043
		Responsiveness	0,086	8	0,037
Make	0,357	Flexibility	0,064	9	0,034
				10	0,045
		Assets	0,044	11	0,028
		Reliability	0,119	12	0,034
				13	0,066
Deliver	0,125	Responsiveness	0,130	14	0,065
				15	0,067
		Reliability	0,104	16	0,051
				17	0,062
				18	0,061
Return	0,118	Responsiveness	0,110	19	0,066
				20	0,051
		Reliability	0,057	21	0,043
		Responsiveness	0,041	22	0,039
				23	0,039

Based on the result of weighting by using the AHP method; the highest value on Level 1 is obtained, which is on the Make process - with a weight value of 0.357. This is because X Weaving Company considers the production process as the process that most determines the quality of the product. If the production goes well, the quality and quantity of the product produced will be good. On level 2, the Responsiveness attribute of the Make process

obtained the highest value; with a weight value of 0.130. This is because X Weaving Company considers the speed of the production process can increase consumer satisfaction. On level 3, KPI of The time needed to produce the product obtained the highest value; with a weight value of 0.067. This is because X Weaving Company receives many orders every day, so that a fast production process is needed.

CONCLUSION

Based on the result of weighting by using the AHP method; the highest value on Level 1 is obtained, which is on the Make process - with a weight value of 0.357. This is because X Weaving Company considers the production process as the process that most determines the quality of the product. If the production goes well, the quality and quantity of the product produced will be good. On level 2, the Responsiveness attribute of the Make process obtained the highest value; with a weight value of 0.130. This is because X Weaving Company considers the speed of the production process can increase consumer satisfaction. On level 3, KPI of The time needed to produce the product obtained the highest value; with a weight value of 0.067. This is because X Weaving Company receives many orders every day, so that a fast production process is needed.

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